Original Article

Safety perceptions of different plant designs in pedestrian and car streets

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Abstract This study was conducted to determine the effects of safety factors on site preferences and offer suggestions for site design by evaluating the role of plant materials in the design of safe urban landscapes. Images taken from the centre of Ataturk University's campus were visually assessed. A total of 10 images representing periods of foliation and dormancy were studied. Eighty-one participants were asked to assess the images presented within the predetermined parameters. Overall, people felt safer in the environment during the period of seasonal foliation. Sites clearly defined by the differences in plant tissue were perceived to be more secure. Participants preferred the environment aesthetically and felt more secure during the period of full foliation. When considering the final data, it was discovered that there was a positive correlation between preference and security ($r = 0{,}558$, $P < 0.01$). Factors used in the analysis and design of contemporary landscapes include topography, climate, land and water. Landscape design that causes a feeling of insecurity within a space should be avoided. Nowadays, the perception of security in open areas has become an important issue. In this study, plant design and aesthetics of urban climate were found to be important in terms of human perception.
URBAN DESIGN International (2014) **19,** 303–310. doi:10.1057/udi.2013.26; published online 2 October 2013

Keywords: preference; visual perception; urban landscape; safety

Introduction

Human needs are often overlooked when considering changes in the quality of the physical environment. Lang (1994) classifies people's needs in urban areas as basic, communicative and aesthetic. Lang also sub-classifies basic human needs as physiological, security, shelter, community, respect and self-expression.

People's judgements about the acceptability of different kinds of human activity in natural environments often seem to stem from an underlying sense of how humans are (or ought to be) related to non-human nature. This question is sometimes framed in terms of a contrast between two basic views. Simplistically stated, these are 'people are separate from nature' and 'people are part of nature'. The first of these two statements represents a belief that human beings are somehow different or separate from the natural world. This view implies that since humans are not part of nature, the presence of people, their artefacts and their activities necessarily must diminish the naturalness of an environment. The second statement represents the belief that human beings belong to the natural world and cannot be set off from the natural systems with which they interact. As, in this view, nature includes human beings, it would seem that there is no reason to view human influence, activities and artefacts as incompatible with natural environments (Schroeder, 2007).

When designing landscapes, there are several factors to consider concerning human needs. Natural, physical, social and economic characteristics should be evaluated together in the assessment of the quality of outdoor areas.

This study seeks to demonstrate how designed natural areas impact urban environments. Several studies suggest that the reclamation of

natural areas increases the value of an area in the overall landscape quality assessment (Parsons, 1991). In this respect, urban green areas that are a natural aspect of cities should be carefully evaluated in planning and management practices.

Today urban areas contain nearly half of the world's population. Overpopulation and cultural differences in urban areas are examples of some of the causes of unsafe urban development. The need for security can sometimes take priority over all other basic needs (Ergun and Yirmibeşoğlu, 2005). In this respect, it can be said that the overall goal of urban design should be to improve quality of life. Residential areas increase in value when environmental quality is improved.

Psychological safety is often defined by the need to feel some control over one's environment. Part of feeling in control in an environment comes from being aware of one's location and not getting lost socially and physically (Lang, 1994).

The focus site of this study is the campus of Ataturk University. Universities provide individuals with scientific, academic and educational opportunities. In this respect, quality environmental conditions of universities are very important as people work to improve themselves. The students either staying on the campus or off campus actively use the campus area, especially the pedestrian streets, during the academic year. Pedestrian streets are commonly used by the students for connections between college, library, dormitory, sport complexes and so on and the city centre. The car streets are also important for circulation, although they are not as active as the pedestrian streets.

According to studies, emotional well-being improves with age (Waldinger *et al*, 2011), and young people are in a critical period emotionally and psychologically. Psychological conditions of individuals are closely linked to where they live and its natural and cultural identity. Grahn and Stigsdotter (2004) reported on the favourable effects of green areas on people who spend their leisure time in these areas. There are also several studies on the visual effects of vegetation in urban and rural areas (Daniel and Boster, 1976; Müderrisoğlu ve Eroğlu, 2006), which reported the effect of visual perception on management decisions and green area use.

Landscape quality assessment is an integral part of environmental planning and management and an active study area in the field of environmental perception (Daniel and Meitner, 2001). It is believed that landscape is a physical reality characterized by different measurements independent of human factors, while it is also a reality dependent on individual perceptions of human beings. These perceptions can be characterized and measured (Palmer and Hoffman, 2001).

The evaluation of participants in landscape visual quality assessment studies is a widely used and accepted method based on image presentation (Clay and Daniel, 2000; Tahvanainen *et al*, 2001; Clay and Smith, 2004; Biénabe and Hearne, 2006; Fuante de Val *et al*, 2006; Müderrisoğlu *et al*, 2006; Sullivan and Lovell, 2006; Bulut and Yilmaz, 2008).

This study seeks to determine the effect of safety factors on site preference in urban areas and safety perception and site preference based on differences in plant design materials, and to evaluate the elements of sites that are considered safe based on the chosen study periods in the sample of pedestrian and vehicle pathways in the central campus area at Ataturk University.

Methods

The study area is the centre of Ataturk University's campus in the city of Erzurum located in the north of East Anatolia Region (Figure 1). The city is the largest in the region with a population of 360 000. The elevation of the campus is 1850 m. Ataturk University comprises 20 faculties, 7 institutes, 4 colleges, 12 vocational schools and 19 research centres. The university has nearly 60 000 students during the academic year, and the number of students increases each year. Land appropriated for housing, management, facilities, common use buildings, dormitories and green space covers a surface area of 3300 ha. The common use buildings include banks, cafeterias, centres for leisure activities, a cinema, exhibition centres, ceremonial and festival spaces, a sports hall, and a small shopping centre (Anonymous, 2013). Owing to these characteristics, the campus area is a fantastic place both for the students and for the people living in the city. The campus area is also a good place both for groups during their spare time and for the people visiting the hospital that is located on the campus.

The Scenic Beauty Estimation (SBE) method developed by Daniel and Boster (1976) and tested in several studies (Tahvanainen *et al*, 2002) was used in the landscape quality assessment of this

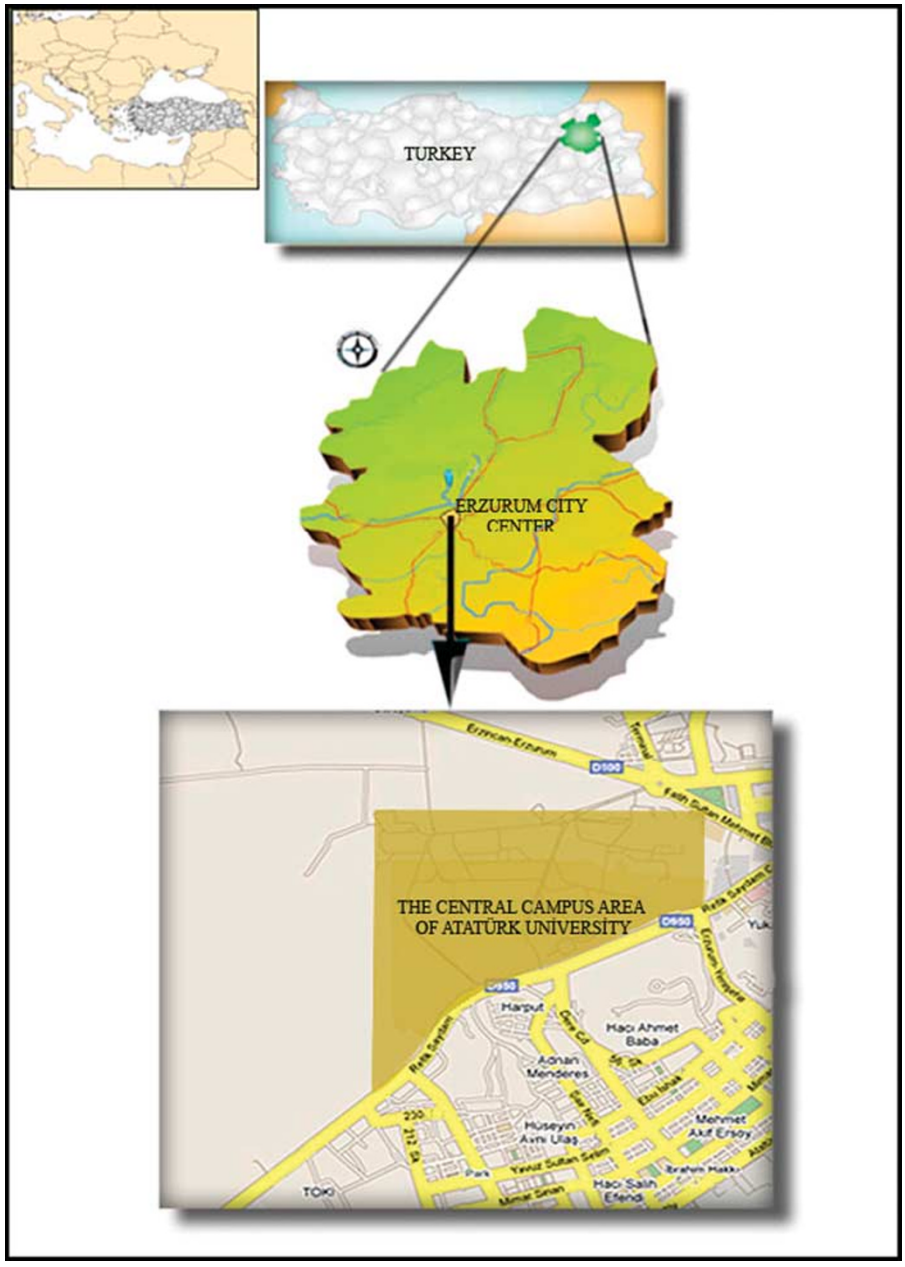

Figure 1: Geographic location of the site.

study, while images and simulations rather than real landscape characteristics were used in perceptive assessment (Clay and Daniel, 2000; Tahvanainen *et al*, 2001; Clay and Smith, 2004; Meitner, 2004; Ikemi, 2005; Fuante de Val *et al*, 2006; Müderrisoğlu and Eroğlu, 2006; Vandenberg and Koole, 2006; Bulut and Yilmaz, 2008; Chen *et al*, 2009; Özhanci *et al*, 2012). In the present study, participants were shown the images and asked to assess them for the evaluated parameters.

Imagery

Images were taken from various parts of the study area (Figure 2) during two different vegetation periods in order to monitor the changes in foliation and dormancy during two different seasons. Frequently used active green space was chosen for the study. For the collection of images, a Nikon D40 digital camera was used between the hours of 11:00 and 17:00 in winter and summer. During

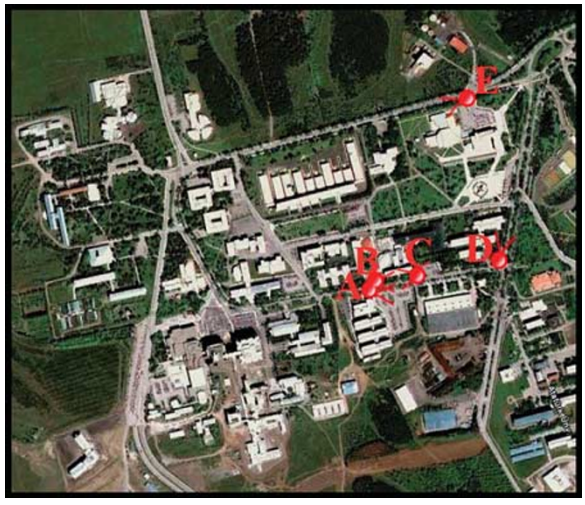

Figure 2: The points where photos taken for analysis (A, B, C, D, E).

each period, an average of 200 images were taken in order to select and assess the 10 best-quality images from the total of 400 (Figure 3).

Participants

Participants of the visual assessment were made up of 81 students, from the Department of Landscape Architecture and from the Photography and Graphic Design Department in the School of Fine Arts, 44 males and 37 femaleswith a median age of 21. Since the evaluation was based on photographical technique, the group of participants was chosen from the departments mentioned above because it was thought that these students have experience in visual perception.

Visual assessment

Participants were first informed about the aim and content of the study. A total of 10 images taken from the area were shown to the subjects as a group and then individually. Participants were asked to score the images for preference level and the feeling of safety on a scale from 0 to 4. The following questions were used in the scoring of preferences: 0 'I don't like this area; 1 'I sometimes like this area'; 2 'I like this area'; 3 'I like this area a lot'; and 4 'I like this area very much'. When gauging the level of safety participants felt with regard to the images, the following questions were used: 0 'I never feel safe in this area'; 1 'I sometimes feel safe in this area'; 2 'I feel safe in this area'; 3 'I feel mostly safe in this area'; and 4 'I feel very safe in this area'.

Statistical analysis

SPSS 10.0 statistical software was used to evaluate the results of the scores. In the analysis, Spearman's Correlation test and the Paired Sample *T*-test were used to compare the averages.

Results

Mean and standard deviations of the scores were given to all images used in the study according to the preference and security parameters presented in Table 1.

Mean scores of the images are also given in Figure 4.

The results of the study showed that the highest safety scores were given to images B2 (M=2.89), C2 (M=2.69) and E2 (M=2, 68) whereas the lowest scores were given to images D1 (M=1, 55), A1 (M=1.85) and B1 (M=1.85; Figure 5).

When considering the parameter scores, it was observed that there is a positive correlation between preference and safety (r=0,558, P<0.01; Table 2).

When evaluating the scores of the different types of images (with the presence of plant material versus no plant material) for preference and safety, it can be determined that the images taken during the period of foliation gained higher scores and that mean scores of both preference and safety were higher than during the leafless period (Table 3).

Tables 4 and 5 represent the results of the Paired Sample *T*-test carried out to determine the statistical significance levels of calculated mean differences. It can be seen that there is a statistically significant relationship between safety and preference means according to image type (foliated and defoliated; P<0.01).

Discussion and Conclusion

Among the social areas, the university campus areas are the most specific place for single walkers. The campus of Ataturk University has different open-area use systems where pedestrian and car streets are active, compulsory and generally single-use areas. It is possible to experience plants as a natural element in the campus throughout the year.

Figure 3: Images used in the study; Defoliated site (left), Foliated site (right).

The participants were not able to judge whether the plants were foliated or defoliated, but it was useful to evaluate whether the texture differentiation has an effect on safety perception.

The data analyses indicated that:

1. Participants preferred and relied on photos from the period of foliation. Among the images

Table 1: Mean and standard deviation for each selected image

		Mean(M)	*Std. deviation*
A1	Preference	1.41	0.93
	Safety	1.85	1.30
A2	Preference	2.47	0.95
	Safety	2.40	1.04
B1	Preference	1.69	1.08
	Safety	1.85	1.13
B2	Preference	2.89	1.04
	Safety	2.51	1.03
C1	Preference	1.80	1.10
	Safety	1.99	1.28
C2	Preference	2.73	0.90
	Safety	2.69	1.00
D1	Preference	1.73	1.15
	Safety	1.55	1.27
D2	Preference	2.73	1.10
	Safety	2.20	1.34
E1	Preference	2.44	1.13
	Safety	2.25	1.19
E2	Preference	2.70	1.16
	Safety	2.68	1.03

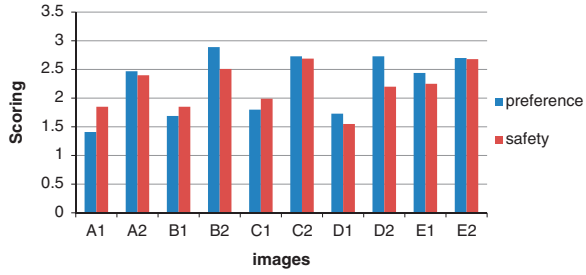

Figure 4: Histogram showing distribution scores received in analysis of the images.

it was B2 (M=2.89), C2 (M=2.69) and E2 (M=2.68) that were taken during the summer months and received the highest preference and safety scores. When these images are evaluated, it can be determined that the elements constituting the images are very clear, their design is simple and the perception of the area is very easy. The mentioned points are effective factors in both area preference and safety perception. In this respect, Kaplan and Hepcan (2004) stated that the shade from tall trees and their outlining characteristics can make an environment attractive for use.

Common characteristics of the images used in this study included a clearly outlined area composed of mature trees with foliage growing in contrasting directions. A clearly defined sense of direction is a characteristic of the area.

2. Among the images the lowest scores were received by D1 (M=1, 55), A1 (M=1.85) and B1 (M=1.85). All of these images were taken from the period of defoliation and participants felt that without foliage, the space failed to provide a sense of place or security.

   The area in image D1 was outlined by a group of shrubs; however, it might again evoke a sense of insecurity because this was a period of defoliation and the dormant plants showed signs of weak textural structure, which might have also caused confusion of the area.
3. When considering the scores of parameters, it was determined that there was a positive correlation between preference and security (r=0,558, P<0.01), which means that safety is a crucial element in the preference of urban green space.

In the present study, the images receiving high scores in terms of visual assessment were taken during the period of foliation. These images were not only more frequently preferred but also gave participants a sense of security. When considering the images, it can be stated that people want to see the entire space at once as well as clearly defined pathways. The use of plants to create strong vertical and horizontal axes both orients the user and creates a feeling of security.

Design of open green spaces and living areas can not only implement many functions (for example, provide shade, increase oxygen production, reduce carbon dioxide, increase humidity and provide protection from wind) but also provide therapeutic benefits by engaging the senses. Stressful environments caused by an increase in environmental problems and its effects on people with socio-economic problems can lead to a rise in criminal activity.

The focus area of this study was chosen because of its centralized location within a university campus. The area is typically thought of as a safe multi-use green space. Participants chosen for the study use the space as a part of their daily activities on campus; therefore, they are familiar with the space. However, this model can be applied to different

Figure 5: (**a**) highest-rated images; (**b**) lowest-rated images.

Table 2: Correlation between preference and safety

		preference	*safety*
Preference	Correlation coefficient	—	0.558*
	Sig. (2-tailed)	—	0.000
Safety	Correlation coefficient	0.558*	—
	Sig. (2-tailed)	0.000	—

*$P<0.01$.

Table 3: Scores of image types (leaved or leafless) for preference and safety parameters

		Mean	*Std. deviation*
Preference	Leaved	1.81	1.13
	Leafless	2.70	1.04
Safety	Leaved	1.90	1.25
	Leafless	2.49	1.10

geographic locations and participants can be identified using a variety of parameters.

Some factors used in the analysis and design of contemporary landscapes include topography, climate, land and water. The programming of urban green space requires that considerations be made for comfort and security. Landscape design that causes a feeling of insecurity within a space should be avoided. A holistic approach to landscape design provides a sense of security, varied plant material, ecological restoration and management, as well as improvement to the aesthetic qualities of the environment.

Table 4: Results of paired sample *T*-test carried out to determine the statistical significance levels of calculated mean differences (preference)

	Mean	*Std. deviation*	*t*
A1–A2	−1.0617	0.9663	−9.889*
B1–B2	0.7778	1.1402	6.139*
C1–C2	−0.9359	1.1205	−7.377*
D1–D2	−1.0127	1.1035	−8.156*
E1–E2	−0.2625	1.1334	−2.071*

*$P<0.01$.

Table 5: Results of paired sample *T*-test carried out to determine the statistical significance levels of calculated mean differences (safety)

	Mean	*Std. deviation*	*t*
A1–A2	−0.5432	1.0960	−4.461*
B1–B2	−0.6543	1.5013	−3.922*
C1–C2	−0.7037	1.1667	−5.429*
D1–D2	−0.6500	1.3697	−4.245*
E1–E2	−0.4250	1.0527	−3.611*

*$P<0.01$.

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